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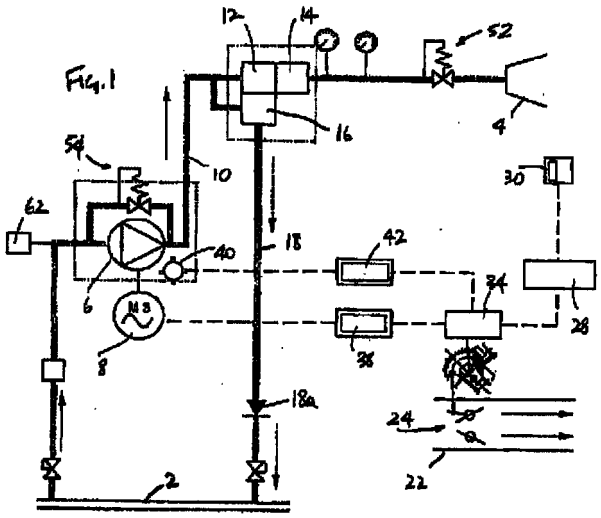
(54) Oil fuel burner systems

(57) An atomising oil fuel burner utilises a variable speed positive displacement pump (6) to supply oil fuel to an atomiser (4) . A controller (28) receives signals of the heat demand and adjusts the air and fuel supply accordingly by control of an air damper 24 and by varying the speed of the oil fuel pump. The speed of the pump and the damper setting are monitored to confirm the fuel air mixture ratio supplied to the atomiser. Control of the burner fuel supply is thereby simplified and made independent of the oil fuel viscosity.



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Description

[0001] This invention relates to atomising oil fuel burner systems and is concerned with the regulation of the fuel supply in such systems.

[0002] In known oil fuel burner systems the oil supply, which may be drawn from a ring main feeding a number of such systems in parallel, is driven at pressure by a pump through a flow control arrangement where, according to the demand in the appliance in which the burner is employed, the required rate of flow of fuel is delivered to the burner and surplus flow from the burner is returned to the ring main, or other supply source upstream of the pump.

[0003] Although this known arrangement has been proved to operate satisfactorily, the control of the fuel flow requires relatively complicated mechanism, particularly if it is required to be insensitive to variations in the viscosity of the fuel oil, with consequent disadvantages in terms of costs and maintenance. Also, since the oil pump must deliver fuel at a sufficient rate to satisfy the maximum rated demand, independently of the varying actual demand, there are considerable power losses.

[0004] According to the present invention, there is provided an atomising oil fuel burner system comprising a positive displacement pump for delivering fuel to an atomising device and a forced draft air supply means for delivering combustion air to the atomised fuel oil, a control arrangement for regulating the fuel and air supply for combustion, the fuel pump being driven by a variable speed motor regulated by said control arrangement to vary the pump speed in order to determine the rate of fuel delivery to the atomising device.

[0005] Preferably, the speed of the fuel pump is monitored and the monitoring signal is employed in the control of the burner system. For example, the signal can provide confirmation of fuel flow without which start-up is inhibited. The signal also provides a convenient input for monitoring the fuel-air mixture ratio with burner system.

[0006] Conveniently, the control arrangement regulates the rate of rotation of the fuel delivery pump and the rate of combustion air flow to the atomising device in conjunction with each other, in order to match the fuel and air flow rates.

[0007] An embodiment of the invention will be described by way of example with reference to the accompanying schematic drawings, in which:

Fig. 1 is a diagram of the oil and air metering assembly for a rotary cup burner,

Fig. 2 is a simplified block diagram of the control arrangement of the assembly of Fig. 1, and

Fig. 3 is a flow diagram illustrating some of the functions of the control assembly.

[0008] Referring to Fig. 1, fuel oil from a ring main 2 flows through separate branch circuits to a plurality of rotary cup atomisers, only one such branch circuit with its atomiser 4 being shown in Fig. 1. The fuel supply for the atomiser 4 is drawn from the ring main 2 by a positive displacement rotary pump 6 driven by a motor 8. The fuel delivery line 10 from the pump leads to a three-way oil valve assembly comprising two normally closed ports 12,14 arranged in series through which the fuel oil must flow to reach the atomiser 4, and a normally open return port 16 leading back to the ring main 2 through a return line 18 non-return valve 18. The valve assembly 12,14,16 is controlled by a burner management system 20 (Fig. 2) which is not shown or described in detail as it can be generally conventional.

[0009] A fan (not shown) drives air under pressure through a delivery duct 22 to the atomiser 4. The rate of flow through the duct may be controlled by regulating the speed of the fan, but in the illustrated arrangement a motorised cam adjusts the positions of dampers 24 in the duct 22 for this purpose.

[0010] The rate of flow of fuel and air while the burner is operating are regulated by a fuel management unit comprising a modulation controller 28 which may be of known form and therefore does not need to be described in detail. The controller 28 has an input from a thermostat 30 responding to the medium heated by the burner 4, eg. boiler water, and outputs signals for controlling the speed of the fuel pump 6 and the position of the air dampers 24 accordingly. Thus, during the operation of the burner the controller 28 responds to the heat demand signalled by the boiler thermostat 30 to increase or decrease the flows of fuel and air. It is possible to actuate the controller from other controlling parameters, of course, such as boiler pressure.

[0011] The control output signals from the controller are received by an actuator 34 driving the motorised cam 36 which operates the air duct dampers 24. The damper actuator 34, also transmits an input signal, proportional to the output signal driving the cam 36, through an inverter 38, to a pump actuator controlling the oil pump motor 8. The pump delivery rate is proportional to the speed of rotation and that speed is monitored by a sensor 40. The signal from the sensor is fed to a comparator 42 which receives a second input corresponding to the input signal to the pump motor actuator, and which is thus proportional to the air flow. A comparator output derived from the difference of these signals is transmitted through line 44 to the burner management system 20 which can shut down the fuel supply system if the indicated rate of rotation of the pump shows that the rate of fuel delivery differs from that intended by more than a permitted margin.

[0012] The speed sensor signal is also sensed by the burner management system to be employed during start-up of combustion. The normally closed ports 12,14 cannot be opened by the burner management system until the sensor indicates the oil pump has reached a sufficient minimum speed.

[0013] A back pressure valve assembly 52 con-

nected between the three-way valve 12,14,16 and the atomiser 4 is able to balance variations in the feed pressure to maintain a pressure difference across the pump. A further back pressure valve assembly 54 connected across the pump operates as an overpressure relief valve.

[0014] Combustion start-up is under the control of the burner management system 20, which is able to initiate the start-up of the burner in a sequence which includes the ignition of a pilot burner (not shown). The burner management system has a cam timer to time out the start-up sequence, whereupon an actuating signal is sent from the burner management system to the modulation controller 28. The modulation controller 28 then starts up the combustion air fan and holds the dampers 22 at a medium setting in order to purge the passageways leading from the burner in known manner. The signal from the modulation controller also acts, through the damper actuator 34, to start up the fuel pump motor 8, but the burner management system 20 leaves the inlet ports 12,14 closed at this stage and the flow from the pump 6 is returned to the ring main through the normally open port 16.

[0015] The air purge is ended by a further timing signal from the burner management system 20 which starts the rotation of the cup atomiser 4 and operates the modulation controller 28 to adjust the dampers 22 and the pump motor 8 to give low rates of flow of fuel and air. In this operation, the comparator 42 proves the air-fuel ratio by comparing the speed sensor signal with the air damper setting signal, to allow the burner management system 20 to switch the three-way valve and so open the ports 12,14 and close the port 16. The modulation controller 28 now takes over control of the damper setting and pump motor speed, in accordance with demand signal from the thermostat 30, or other demand sensor. The firing rate and instantaneous oil flow are thus continually updated during the operation of the burner.

[0016] Because the fuel delivery rate is determined solely by the rate of rotation of the pump, the system is not sensitive to changes in the viscosity of the oil.

[0017] It is of course possible within the scope of the invention to connect a plurality of atomising burners in parallel to the same positive displacement pump, the rate of flow to each of the burners then being dictated by varying the pump speed.

[0018] Fig. 3 illustrates further features of the start-up sequence of the burner control arrangement in the embodiment of Figs 1 and 2. Initially, when the burner switch is moved to the "on position", if a dense fuel such as residual fuel oil is being used, the pump motor is started while isolated from the atomiser and a checkstat 62 connected to the burner management system 20 monitors its rate of rotation so that it can run at half speed to warm the oil in the branch from the ring main.

[0019] With lighter grades of fuel, this initial step is omitted and the burner start procedure is initiated in response to the heat demand sensed by means (not shown), in the manner already described.

[0020] If the air fuel ratio is detected by the respective sensors to move outside a pre-set band, the control burner management system 20 will shut down the burner in known manner.

[0021] Although the illustrated example in Fig. 1 shows all the pumped flow being directed to the atomiser 4 when the valve ports 12,14 are open, it may be preferred to bleed a part of that flow into the return line 18 to the ring main as one way of ensuring that the temperature of the return line does not drop below a satisfactory level. If this is done, the bleed flow is taken in a manner that maintains a relationship between the pump speed and the rate of fuel delivery to the cup burner, and preferably the bleed flow is maintained substantially constant independently of the pump output rate to give a direct relationship between change of pump speed and the rate of fuel delivery to the atomiser.

Claims

1. An atomising oil fuel burner system comprising a positive displacement pump for delivering fuel to an atomising device and a forced draft air supply means for delivering combustion air to the atomised fuel oil, a control arrangement for regulating the fuel and air supply for combustion, the fuel pump being driven by a variable speed motor regulated by said control arrangement to vary the pump speed in order to determine the rate of fuel delivery to the atomising device.

2. A burner system according to claim 1 wherein the control arrangement also regulates the rate of delivery of combustion air through said forced flow system and monitors the fuel and air flow control settings in dependence upon each other to maintain a fuel-air mixture within predetermined limits.

3. A burner system according to claim 2 wherein said air flow control comprises a variable speed fan and/or an adjustable damper in the air flow path.

4. A burner system according to any one of the preceding claims wherein a speed sensor monitors the operation of the fuel pump and the control arrangement is responsive to the output from said sensor.

5. A burner system according to claim 4 wherein the control arrangement is arranged to compare a signal from the pump speed sensor with a setting for the combustion air supply to the burner to monitor the fuel-air mixture ratio.

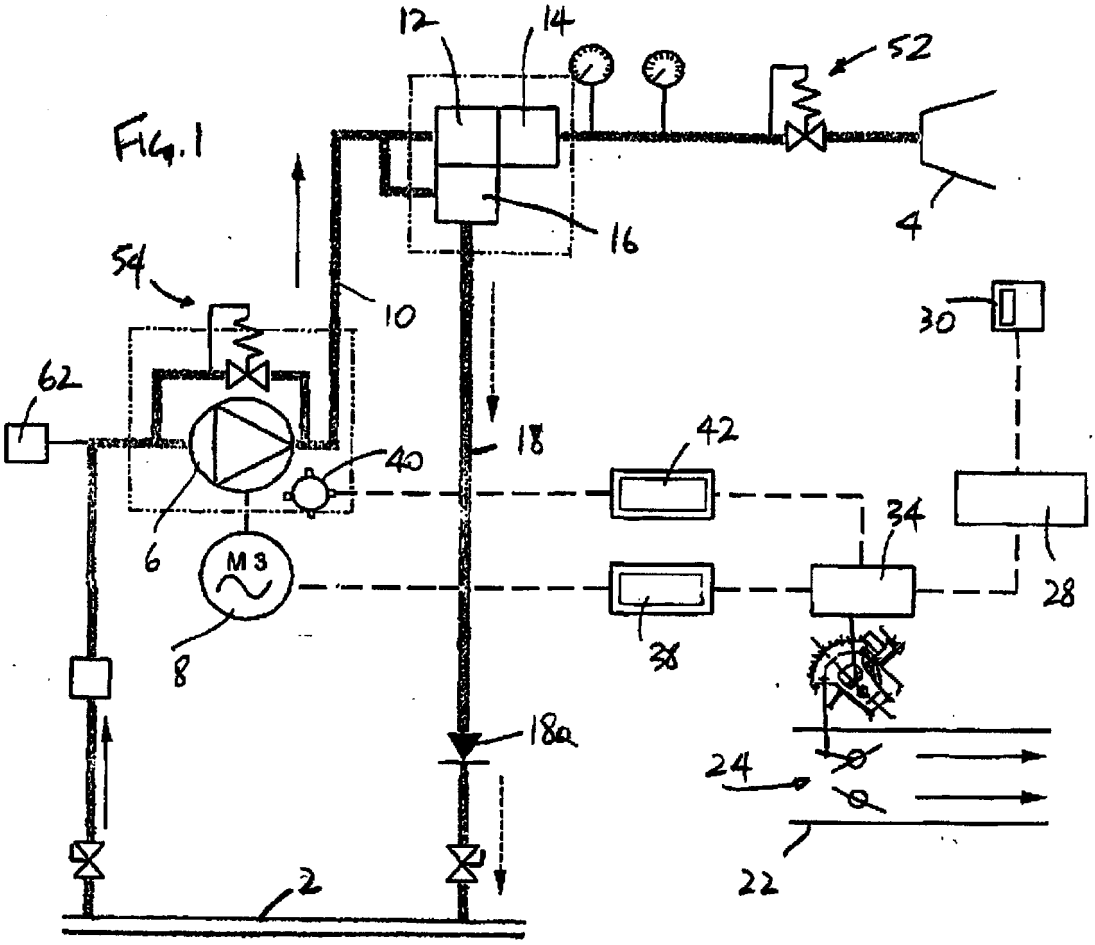
6. A burner system according to claim 4 or claim 5 wherein the speed sensor signal is arranged to initiate shut-down of the burner system in the event of

a predetermined pump speed not being attained during start of operation of the burner system.

7. A burner system according to any one of claims 4 to 6 wherein the control arrangement inhibits start-up of the burner system until rotation of the pump is detected by said sensor.

8. A burner system according to any one of the preceding claims wherein a plurality of atomising devices are connected in parallel to the pump delivery.

Fig. 1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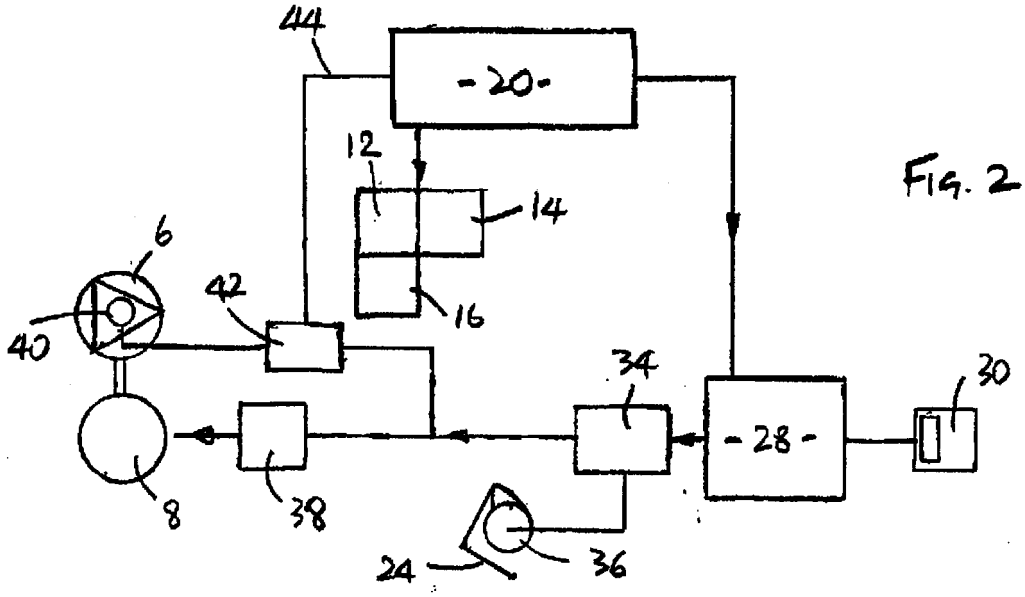
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Fig. 2

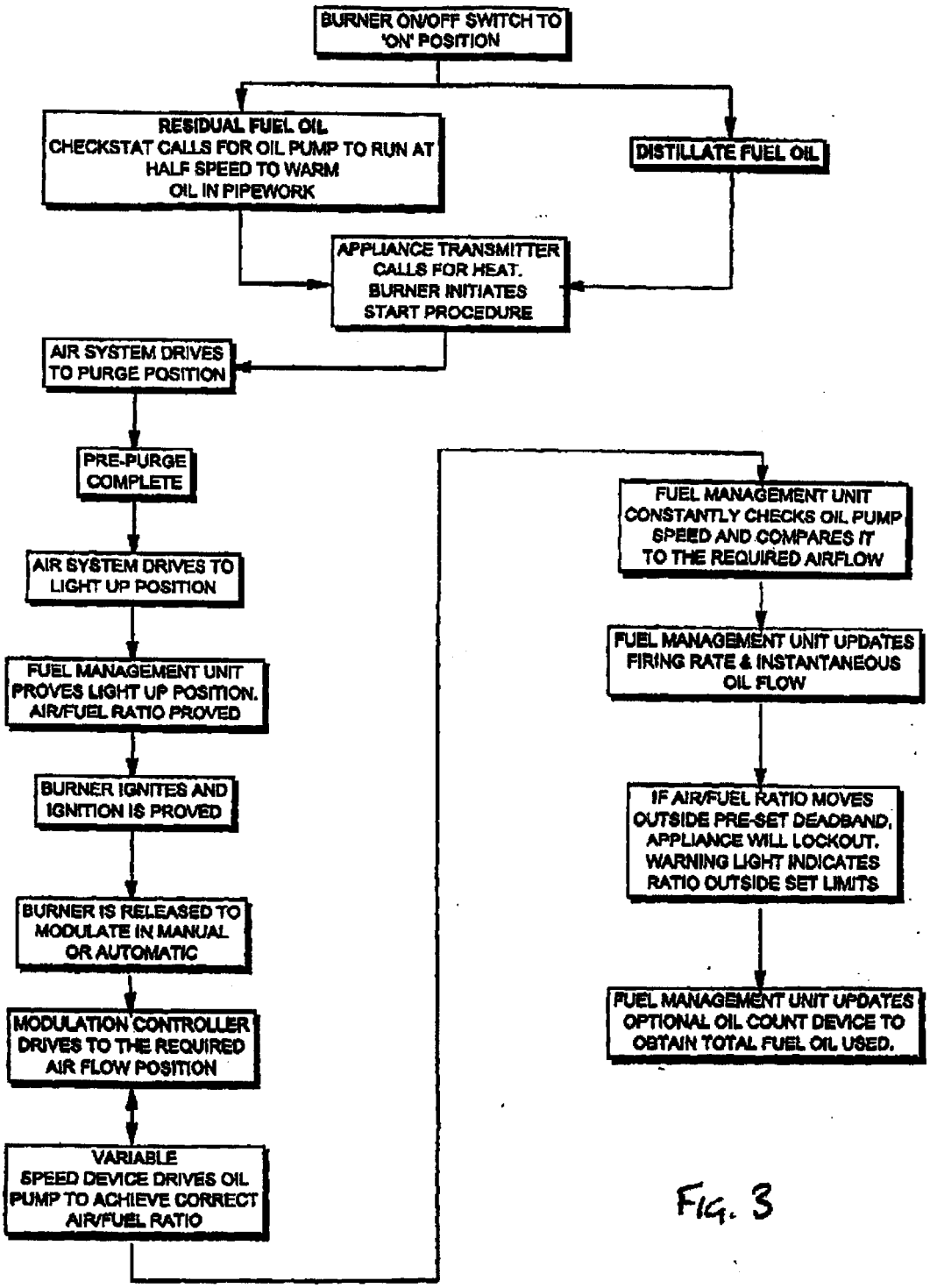
BURNER ON/OFF SWITCH TO 'ON' POSITION
RESIDUAL FUEL OIL CHECKSTAT CALLS FOR OIL PUMP TO RUN AT HALF SPEED TO WARM OIL IN PIPEWORK
DISTILLATE FUEL OIL
APPLIANCE TRANSMITTER CALLS FOR HEAT. BURNER INITIATES START PROCEDURE
AIR SYSTEM DRIVES TO PURGE POSITION
PRE-PURGE COMPLETE
AIR SYSTEM DRIVES TO LIGHT UP POSITION
FUEL MANAGEMENT UNIT PROVES LIGHT UP POSITION. AIR/FUEL RATIO PROVED
BURNER IGNITES AND IGNITION IS PROVED
BURNER IS RELEASED TO MODULATE IN MANUAL OR AUTOMATIC
MODULATION CONTROLLER DRIVES TO THE REQUIRED AIR FLOW POSITION
VARIABLE SPEED DEVICE DRIVES OIL PUMP TO ACHIEVE CORRECT AIR/FUEL RATIO
FUEL MANAGEMENT UNIT CONSTANTLY CHECKS OIL PUMP SPEED AND COMPARES IT TO THE REQUIRED AIRFLOW
FUEL MANAGEMENT UNIT UPDATES FIRING RATE & INSTANTANEOUS OIL FLOW
IF AIR/FUEL RATIO MOVES OUTSIDE PRE-SET DEADBAND, APPLIANCE WILL LOCKOUT. WARNING LIGHT INDICATES RATIO OUTSIDE SET LIMITS
FUEL MANAGEMENT UNIT UPDATES OPTIONAL OIL COUNT DEVICE TO OBTAIN TOTAL FUEL OIL USED.

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 9796

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 614 048 A (LANDIS & GYR BUSINESSS SUPPORT) 7 September 1994 * column 2, line 24 - column 7, line 33; figure *	1-7	F23N1/02 F23K5/04 F23N5/24
X	EP 0 623 785 A (LANDIS & GYR BUSINESS SUPPORT) 9 November 1994 * column 4, line 1 - column 5, line 38; figure *	1-5	
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 105 (M-1092), 13 March 1991 & JP 03 001012 A (WALBRO FAR EAST INC), 7 January 1991 * abstract; figure *	1-3	
A	EP 0 764 817 A (ERNST-APPARATEBAU) 26 March 1997 * the whole document *	1-5	
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 558 (M-1493), 7 October 1993 & JP 05 157059 A (MITSUBISHI HEAVY IND LTD), 22 June 1993 * abstract; figure *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23N F23K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 March 1999	Kooijman, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 30 9796

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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26-03-1999

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82